



## LCD DRIVER FEATURES

### Supported LCD Sizes

1 x 16, 2 x 8, 2 x 12, 2 x 16, 2 x 20, 4 x 16, 4 x 20

Commands	Format
Display ASCII Text	ASCII Chars
Clear Display	Esc C
Home Cursor	Esc H
Position Cursor	Esc P XY (X=Line: 1-4, Y=Col: 0-40)
Beep	Esc Z
Display Byte	Esc X (X: 0-255)
Display Word	Esc XY (X=High Byte, Y=Low Byte, 0 - 999d)
Send Control Code	Esc R X (X: 0 - 255)
LEDs	Esc L XY (X=LED #1-4, Y: 1=On, 0=Off)
Cursor Mode	Esc V X (X: 1=Visible, 2=Invisible, 3=Blink)
Software Back Light	Esc J X (X: 1=On, 2=Dim 3=Off)
Configure Driver	Esc D XY (X= # of Lines, 1-4; Y=Char/Line, 8-40)

NOTE: Commands begin with Esc (27 decimal, 1B hex), followed by a command character and any parameters. The command character is ASCII, (e.g., C = 67 decimal, 43 hex). The parameters are numeric (e.g., line numbers 1 through 4 are 1 decimal through 4 decimal). The following sequence sent to the driver will position the cursor on the top line (#1), fifth column (columns start at 0): 27, "P", 1, 4. This can also be sent as 27, 80, 1, 4 (all decimal), where "P" = 80 decimal.

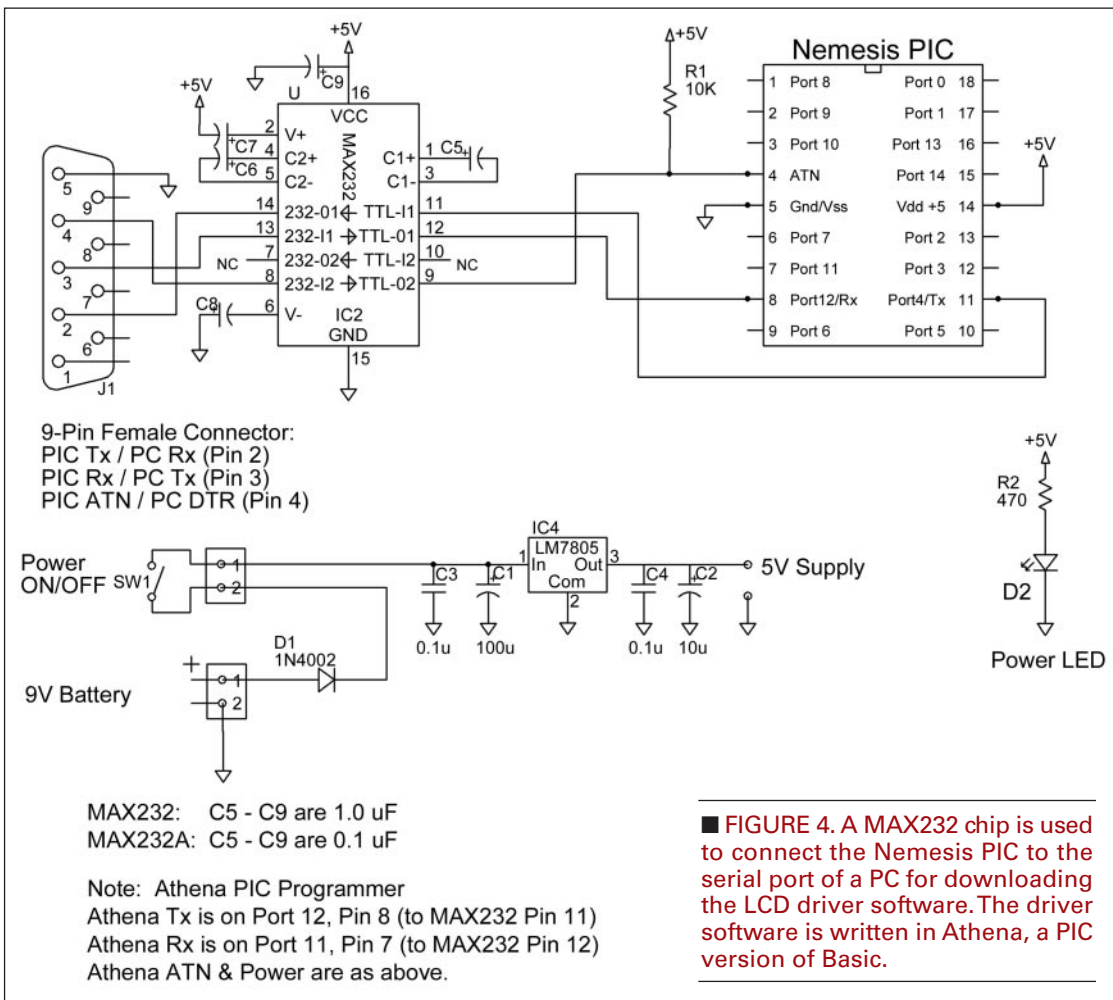
19200. ASCII characters sent to the Nemesis are displayed sequentially from left to right across the current line, as one would expect. Commands are sent to the Nemesis by sending an escape character (27 decimal), followed by the command, and any parameters required.

To clear the display and position the cursor on the top line's leftmost character, one sends 27, "C" to the Nemesis. To position the cursor on the second line, fifth character position, one sends the following sequence: 27, "P", 2, 4. Lines are numbered 1 through 4, based on how many the actual display has. Character positions, however, are numbered 0, 1, 2, ... across the line. Given the ability to position the cursor wherever one desires, formatting one's output is trivial.

Displaying numeric data is also easy. Byte (0-255 hex) and "word" (90-0E7 hex [0-999 decimal]) commands are also included to convert the value from hex to an ASCII character string for display. Most of my projects use carefully formatted displays, positioning the data in desired locations. I have not included automatically wrapping text from the end of one line to the beginning of the next, since I have not required this feature. If one is using the display as a "terminal" displaying streaming data, one can easily incorporate formatting within the project's main processor's output routine, or modify the LCD driver's code.

## Hardware Setup

The Nemesis PIC microcontroller is a



general-purpose device. To be used as an LCD controller, it must first be programmed with the provided LCD controller software. Fortunately, this step is easy. Figure 4 illustrates the Nemesis connected to a MAX232 RS-232 serial communications chip. This chip converts TTL level signals, (0-5 volts), to an inverted,  $\pm 10$  volt signal used to connect to a PC's serial port.

You can download the LCD driver program from the *Nuts & Volts* website ([www.nutsvolts.com](http://www.nutsvolts.com)), and the Nemesis programming software from the Kronos Robotics website. Program the chip, and you are ready to use it as a display driver within your own project.

The LEDs, piezo-electric beeper, and backlight control are all options that are available for use, if desired. One can breadboard the Nemesis and the MAX232 serial communications chip to perform the programming, or purchase a socketed circuit board for the chip and a serial interface board from the Kronos website. Figure 4 illustrates the polarity of the 1  $\mu$ F electrolytic capacitors connected to the MAX232 chip. If the MAX232A version of the chip is used, 0.1  $\mu$ F capacitors are employed. These are non-polarized, and hence may be inserted in either orientation.

## Power

No circuit board layout is provided for this project since, in use, the LCD driver is incorporated into your own main project. A word about power requirements is in order, however. The Nemesis requires a five-volt supply and draw less than 2 mA of

current. The I/O pins can source up to 25 mA each for the LEDs, or other attached devices. If four LEDs are run at 15 mA each, plus a few mAs for the piezo buzzer, the chip could draw 70 mA. This exceeds the current that can be provided by the BASIC Stamp 1's on-board voltage regulator. An external power supply

providing a regulated five volts is required. Without the LEDs, the

## SAMPLE CODE TO DISPLAY INFORMATION ON AN LCD

Data can be sent from a BASIC Stamp, ZBasic Chip, Nemesis, or PIC, etc. The baud rate is either 2400 or 9600, and is selected on the driver chip by tying Port 13 (Pin 16) to ground, or letting it float high, respectively. The data format is N81, no parity, eight data bits, one stop bit. The data is sent as a 5 V (TTL) signal, not as a bi-polar RS232 signal. If one wishes to send data to the LCD from a PC's serial port, a MAX232 type RS232 to TTL converter is required.

### BASIC Stamp — I Example:

```
serout 0,T2400,("ABCDE")           'Outputs text in quotes on pin 0
serout 0,T2400,(65)                 'Also outputs capital A, (65 dec)
serout 0,T2400,(27, "CHi There")   'Cls, then print Hi There
serout 0,T2400,(27, "P",2,0,"12345") 'Prints 12345 on Line 2, Column 0
```

### BASIC Stamp — II Example:

Uses 9600 baud, N81, "non-inverted" by BASIC Stamp manual terminology.

```
serout 0,84,["ABC"]                'Output a Text String in quotes
serout 0,84,[65, 66, 67]            'Output the same, ABC, sent as decimal data
serout 0,84,[27,"CHi There"]       'Cls, then print Hi There
serout 0,84,[27, "P", 1, 5, "***'] 'Now send Position Command to print an * on
                                     'Line 1 at the 6th Character position.
                                     '(Lines are 1, 2, 3, or 4)
                                     '(Columns are 0 - (N-1))
                                     '(27 decimal = Esc Char, used to send a Command)
```

### Nemesis Example:

Uses a general I/O port pin, not the dedicated hardware USART port used for programming and debug.

```
const TxD 14                        'Use Port 14 to send the data to the LCD driver chip
const Esc 27                         'Decimal for Esc code, for commands
output TxD                           'Set this port in output mode
high TxD                             'Set port high before sending serout data
setbaud SBAUD9600                   'Set serial IO to 9600,N81

serout TxD, "This is my Text"
serout TxD, Esc, "P", 1, 5, "***'   'Send Position Command to print an * on Line 1
                                     'at column 6. (SeeBS-II, above)
serout TxD, 27, 80, 1, 5, "***'     'Same as above, sent as decimal data.
```

## LCD DRIVER PARTS LIST

### ITEM

- Nemesis PIC
- LCD

### DESCRIPTION

Kronos Robotics (\$12.95)  
Two Line x 16 Characters  
Crystal Fontz CFAH 1602A-YYB-JP (\$11.87)

### RESISTORS

- R1, R3      10 k $\Omega$ , 1/4 W, 5%
- R2, R4, R5    1 k $\Omega$ , 1.4 W, 5%
- R6, R7, R8, R9 470  $\Omega$ , 1/4 W, 5%
- R6            51  $\Omega$ , 1 W, 5%
- VR1          Potentiometer, 10 K $\Omega$  (LCD contrast control)
- T1            TIP-102 NPN Silicon Darlington Transistor
- PB            Piezoelectric Beeper (3-16V)  
RadioShack RS-273-074
- D1-4         Red LEDs